

## Garden Math

Have you ever stood in front of a display of bags of mulch wondering how many bags you need to cover your flower bed 3 inches deep? How many petunias do you need to fill that same flower bed with flowers? And when it's time to fertilize, how much of a bag of fertilizer do you need to spread? Well, keep reading. Using math in your garden isn't difficult once you know some basic principles.

### Area

Perhaps the most useful measurement of your garden is the area. Area measurements are expressed in square feet (or square yards). You will need to know the area to determine how much fertilizer, seed, or sod your garden needs, or how many plants to buy to fill a bed at the recommended plant spacing. For rectangular or square areas, simply multiply the length times the width to get the area. For a triangular area that has a 90-degree corner, multiply the length times the width and divide the result by 2. For a circular area, measure from the center of the circle to the edge (this dimension is called the radius), multiply this number times itself, and then multiply the result times 3.14 (known as pi). If your garden is irregularly shaped, divide it up into smaller geometric shapes, calculate the area of each, and add them together.

For many useful tables and formulas, check out this web page: [Conversion Tables, Formulas and Suggested Guidelines for Horticultural Use](#).

### Volume

Once you know the area, you can use this number to figure out volume. Volume is expressed in cubic feet or cubic yards. You need to know volume to buy soil amendments, mulch, compost, soil, potting mix, gravel, and many other materials. To calculate volume, measure the depth you need to fill and multiply this times the area. Keep in mind that you have to multiply the same kind of units together-you can't multiply inches by feet. So if you want to cover a flower bed with 3 inches of mulch, first divide 12 into 3 to get how much of one foot you will be needing (in this case,  $3 \div 12 = 0.25$ ). Then multiply this result by the square feet of your flower bed.

Mulch, compost, soil, and gravel are often sold by the cubic yard, and it's more economical to buy it this way than in small bags. One cubic yard is equal to 27 cubic feet, so to convert cubic feet to cubic yards, divide by 27. You can cover approximately 100 square feet of area 3 inches deep with one cubic yard of material. There are more sample quantities and examples later in this article.

### Perimeter

If you want to buy fencing or edging for your garden, you will need to know the perimeter measurement (for circles, this is known as the circumference). To get this number, measure all the sides and add them together. To find the circumference of a circle, multiply the diameter of the circle times 3.14. (The diameter is the distance from the edge, through the center, to the opposite edge.) An easy way to measure the perimeter of circular or curving

areas is to position a garden hose along the edge, curving it to follow the edge (adding additional hoses end-to-end if needed). When you get all the way around, mark on the hose where you stopped, then stretch out the hose straight and measure from the starting end to your mark with a regular tape measure.

## Handy Conversions, Calculations, Examples, and Tables

1 square yard = 9 square feet

1 cubic yard = 27 cubic feet

1 cubic foot = approximately 25.75 dry quarts

1 tablespoon = 3 teaspoons

1 ounce = 2 tablespoons

1 cup = 16 tablespoons

1 pint = 2 cups

1 quart = 2 pints

1 gallon = 4 quarts = 16 cups = 128 ounces of liquid

1 cubic foot = 7.48052 gallons

1 gallon = 0.1337 cubic feet of water

1 gallon of water = 8.3453 pounds

1 cubic foot of water = 62.427 pounds

### Volumes of material

Approximately 1 cubic yard of organic material will cover 100 square feet to a depth of 3 inches. Or, more precisely, 1 cubic yard of organic material will cover 324 square feet to a depth of 1 inch. One way to calculate the number of cubic yards you need is to multiply the area in square feet times the depth of organic material in inches and divide the result by 324.

In all these examples, numbers in parentheses are multiplied together. For instance, “(4)(16)” means “4 times 16.”

### Examples

How many cubic yards of mulch will it take to cover a bed that measures 4 feet by 16 feet to a depth of 3 inches?

First, multiply the length times the width to get the area:  $(4)(16) = 64$  square feet

Then multiply the area times the depth of material:  $(64 \text{ square feet})(3 \text{ inches}) = 192$

Then divide the result by 324:  $192 \div 324 = 0.59$  cubic yards

If you want to convert this to cubic feet, multiply by 27:  $(.59)(27) = 16$  cubic feet

Here is another way to approach the same problem:

Divide the area of your garden bed by 12 (the number of inches in a foot) to find out how many cubic feet you would need for 1 inch of mulch:  $64 \div 12 = 5.33$  cubic feet.

Next, multiply this by the number of inches of mulch you want to add: for 3 inches of mulch you will need  $(5.33)(3) = 16$  cubic feet.

Or:

Calculate how much mulch you want to add in feet by dividing the number of inches by 12. Then multiply this result times the area of your bed. In this example:

$$3 \div 12 = 0.25 \text{ ft}$$

$$(0.25)(64) = 16 \text{ cubic feet}$$

Organic material needed to cover 100 square foot area

Thickness of organic material	Approx. amount needed per 100 square feet
6 inches	2 cubic yards
4 inches	35 cubic feet
3 inches	1 cubic yard
2 inches	18 cubic feet
1 inch	9 cubic feet
½ inch	4 cubic feet
¼ inch	2 cubic feet
Source: Plant Science, Cornell University	

### Organic material needed

To cover this area	2 inches deep	3 inches deep	4 inches deep
100 square feet	0.62 cubic yard	0.93 cubic yard	1.23 cubic yards
250 square feet	1.54 cubic yards	2.31 cubic yards	3.09 cubic yards
500 square feet	3.09 cubic yards	4.63 cubic yards	6.17 cubic yards
1000 square feet	6.17 cubic yards	9.26 cubic yards	12.35 cubic yards

### Number of plants

To calculate how many plants you need, choose the desired spacing from the column at the left in the table below and multiply the area of your garden (in square feet) by the number in the corresponding column at the right. The result is the total number of plants you will need. For example, if your garden is 100 square feet, and you want the plants to be spaced on 8 inch centers, multiply 100 times 2.25. You would need 225 plants.

Spacing	Multiplier
6 inch centers	4
8 inch centers	2.25
9 inch centers	1.77

Spacing	Multiplier
10 inch centers	1.44
12 inch centers	100
15 inch centers	64
18 inch centers	0.444
24 inch centers	0.25
Source: Connie Booth	

## Fertilizer application

Fertilizer application rates are often given in pounds of nutrient per 100 or 1000 square feet. You need to convert from pounds of nutrient to pounds of fertilizer. For example, if your Cooperative Extension office recommends that you add 2 pounds of nitrogen per 1000 square feet of garden, using a fertilizer with a 1:1:1 ratio of nitrogen, phosphorus, and potassium, follow these steps to figure out how much fertilizer to use:

1. Choose a fertilizer with a 1:1:1 ratio, such as 8-8-8.
2. Divide the amount of nitrogen recommended per 1000 square feet (2 lb) by the amount of nitrogen in the fertilizer (8% or 0.08):  $2 \text{ lb} \div 0.08 = 25 \text{ lb per 1000 square feet}$ .
3. Calculate the area of your garden: for example, if your garden is 20 feet long by 25 feet wide, it has an area of 500 square feet.
4. Divide the area of your garden (500 square feet) by the area in the fertilizer recommendation (1000 square feet). Then multiply by the fertilizer amount calculated in step 2 above:  $(500 \div 1000)(25) = 12.5 \text{ lb}$  of 8-8-8 fertilizer. This is the amount needed for your garden.

## More Examples

You have a bag of 35-3-5 fertilizer, which is 35% nitrogen, 3% phosphorus, and 5% potassium. You want to apply 1 pound of actual nitrogen per 1000 square feet of lawn. Your lawn measures 60 feet by 120 feet. How many pounds of 35-3-5 fertilizer do you use to apply 1 pound of actual nitrogen per 1000 square feet?

$1 \text{ lb} \div 0.35 = 2.86 \text{ lb per 1000 square feet}$   
 $(120 \text{ ft})(60 \text{ ft}) = 7200 \text{ square feet of lawn}$   
 $(7200 \text{ square feet} \div 1000 \text{ square feet})(2.86) = 20.6 \text{ lb of 35-3-5 fertilizer}$

If it is recommended that you fertilize a tree with nitrogen at a rate of 3 pounds of nitrogen per 1000 square feet, how much 21-7-14 fertilizer do you need to apply under your tree (assuming the drip line is 20 feet across)?

$3 \text{ lb} \div 0.21 = 14 \text{ lb per 1000 square feet}$   
 $\text{area under tree} = (20)(20) = 400 \text{ square feet}$   
 $(400 \text{ square feet} \div 1000 \text{ square feet})(14) = 5.6 \text{ lb of 21-7-14 fertilizer}$

**Approximate amounts of fertilizer needed to provide 3 lb of nitrogen per 1000 square feet**

Type of fertilizer	Amount of fertilizer to apply
10-6-4	30 lb
12-3-6	25 lb
16-8-8	19 lb
21-0-0	14 lb
21-4-4	14 lb
24-4-8	12.5 lb
33-0-0	9 lb
46-0-0	6.5 lb
Source: Sustainable Gardening	

## References and Additional Resources

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